and 6.7/1000,"

(3) The expression "a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.5/1000," on page37, line 29, in the Claim 3 should be amended as "a mold whose cavity is designed to set X direction, Y direction, and Z direction molding shrinkage ratios of said resin molded article to be the same value each into a range of between 4.5/1000 and 6.5/1000,".

(4) The expression "a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.5/1000," on page38 line 10, in Claim 4 should be amended as "a mold whose cavity is designed to set X direction, Y direction, and Z direction molding shrinkage ratios of said resin molded article to be the same value each into a range of 4.5/1000 and 6.5/1000,",

(5) The expression "a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a renge of between 5.5/1000 and 7.5/1000," on page39 line 7, in Claim 9 should be amended as "a mold whose cavity is designed to set X direction, Y direction, and Z direction molding shrinkage ratios of said resin molded article to be the same value each into a range of between 5.5/1000 and 7.5/1000,".

(6) The expression "a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 5.5/1000 and 7.3/1000," on page39 line 17 in Claim 10 should be amended as " a mold whose cavity is designed to set X direction Y direction, and Z direction molding shrinkage ratios of said resin molded article to be the same value each into a range of 5.5/1000 and 7.3/1000, ".

(7) The expression "a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 5.5/1000 and 7.5/1000," on page39 line 26 in Claim 11 should be amended as "a mold whose cavity is

designed to set X direction, Y direction, and Z direction molding shrinkage ratios of said resin molded article to be the same value each into a range of between 5.5/1000 and 7.5/1000,".

REPLY

To: The Commissioner of Japanese Patent Office

1. Identification of the International Application

PCT/JP03/08332

2. Applicant

Name: SUZUKA FUJI XEROX CO., LTD.

Address: 1900, Ifuna-cho, Suzuka-shi, Mie, 519-0393 Japan

Country of nationality: Japan

Country of residence: Japan

3. Agent

Name: USAMI Tadao

Address: No.102, 32, Tsukimigaoka, Yatomi-cho, Mizuho-ku, Nagoya-shi, Aichi 467-0035 Japan

4. Date of Notification

16.03.04

5. Content of Reply

1. The present invention

In the present invention, the design and manufacture of the mold can be done easily using the same values in the molding shrinkage ratios in X-direction, Y-direction and Z-direction so as not to produce a large fluctuation in the molding shrinkage ratio of the resin molded article, being molded by injecting a fluid at a pressure higher than the atmospheric pressure into the melting resin.

2. Literatures cited

2.1 Literature 1 (TOKKAISHOU 63-268611)

In Literature 1, a method for manufacturing a synthetic resin molded article, having a hollow structure, comprising the injection of a melted resin into a mold cavity, and then injecting a pressured gas (gas assist method) is disclosed, while the object of the present invention is to provide a resin molded article, having a good molding accuracy without sink and warping. Nevertheless, Literature 1 does not teach or disclose that using the gas assist method, design and the manufacture of the mold can be done easily using the same molding shrinkage ratio values in X-direction Y-direction, and Z-direction.

2.2 Literature 2 (TOKKAIHEI 05-16177)

Literature 2 discloses that sink of the resin molded article whose thickness partially varies is prevented by setting a void inserting pin into the part of the cavity of the injection mold, in which thicker part of the resin molded article will be formed, creating a void in the melted resin by effecting pressurized gas from the tip of said pin when the article is being injection molded, and expanding said void to be a corresponding size to the amount of shrinkage of the molded article during cooling.

The object of the disclosure in Literature 2 is to prevent sink caused by the shrinkage of melted resin during cooling and solidifying, while the object of the present invention is to make the design and manufacture of the mold easier by using the same molding shrinkage values in X-direction, Y-direction, and Z-direction.

Accordingly the object of the present invention is quite different from the object of the disclosure in Literature 2, and Literature 2 does not disclose or teach that the object of the present invention can be attained using the gas assist method.

In the present written opinion, it has been commented that in the mold applied in the invention disclosed in Literatures 1 and 2, with the shrinkage of said mold being prevented, it is clear that the shrinkage produced is negligible, and so it is natural to interpret that the molding shrinkage is set to be of an extremely small value. However, the gist of the present invention is not to reduce the molding shrinkage, but to make the design and manufacture of the mold easier by using the same shrinkage ratio values in X-direction, Y-direction, and Z-direction, to prevent a large fluctuation in molding shrinkage ratios making the design and the manufacture of the mold easier by setting the X-direction, Y-direction, and Z-direction shrinkage ratios to be of any value in the range of between 4.5/1000 and 6.6/1000, which may not have been made easily by the expert.

Accordingly, it may not say that the inventions of claims 1 to 8 have been made easily by the expert on the basis of the inventions shown in Literatures 1 and 2.

2.3 Literature 3 (TOKKAISHOU 64-24715)

Literature 3 discloses the prevention of sink by expansion injection molding. Nevertheless, Literature 3 does not disclose that expansion injection molding prevents a large fluctuation in the molding shrinkage ratio of the resin molded article, making its design and manufacture of the mold easier by using the same

shrinkage ra[redacted]values in X-direction, Y-direction, and Z-[redacted]ction. Accordingly, the inventions of claims 9 to 11 may not be easily made by the expert. The invention of claim 12, which follows claims 1 to 11, has naturally an inventive step since it is considered that the inventions of claims 1 to 8 and 9 to 11 have inventive steps as described above.

Further, the objective resin of claim 12 is a recycle resin or a mixture of virgin resin and recycle resin, in which said recycle resin is contained at least in an amount of more than 1% by weight, and various kinds or grades of resins are mixed together in said recycle resin, and further, the resins recycled at varying times are also mixed in, said differences effecting the fluidity and the molding shrinkage ratio. Further, since the melt viscosity of the recycle resin is generally higher than that of virgin resin, mold defects such as short mold, whitening, cracking, silver streaking and the like are apt to arise.(specification Page1, line 31 to Page2, line 14)

Accordingly, in the invention of claim 12 in which the present invention is applied to recycle resin, said problems are solved, and a highly accurate sized article can be manufactured.

Literatures 1, 2 and 3 do not disclose or teach about this advantage of the invention. Accordingly, even if it is well known that the recycle resin can be mixed into the resin for molding in a suitable amount, the invention may not be easily made by the expert on the basis of the disclosures of Literature 1, 2 and 3, and the inventive step of the present invention can not be denied.

6. The list of attached paper: Amendment.

CLAIMS

1. A method for manufacturing a resin molded article made of an acrylonitrile-butadiene-styrene copolymer, or a polymer alloy or polymer blend containing said acrylonitrile-butadiene-styrene copolymer, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.6/1000, the injecting of said acrylonitrile-butadiene-styrene copolymer, or said polymer alloy or polymer blend containing said acrylonitrile-butadiene-styrene copolymer, into said mold cavity, said copolymer, or said polymer alloy or polymer blend, being melted by heating at a temperature higher than 160° C, and then the injecting of a fluid at a pressure higher than the atmospheric pressure during, or after the injection of said copolymer, or said polymer alloy or polymer blend.
2. A method for manufacturing a resin molded article made of a high impact polystyrene, which is a polymer blend of a styrene graft butadiene copolymer, and a styrenic polymer, or a polymer alloy or polymer blend containing said high impact polystyrene, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.7/1000, the injecting of said high impact polystyrene, or said polymer alloy or polymer blend containing said high impact polystyrene, into said mold cavity, said high impact polystyrene, or said polymer alloy or polymer blend containing said high impact polystyrene, being melted by heating at a temperature higher than 160° C, and then the injecting of a fluid at a pressure higher than the atmospheric pressure during, or after the injection of said high impact polystyrene, or said polymer alloy or polymer blend containing said high impact polystyrene.
3. A method for manufacturing a resin molded article made of a modified polyphenylene ether, or a polymer alloy or polymer blend containing said modified polyphenylene ether, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.5/1000, the injecting of said modified polyphenylene ether, or said polymer alloy or polymer blend containing said modified polyphenylene ether, into said mold cavity, said modified polyphenylene ether, or said polymer alloy or polymer blend containing said modified polyphenylene ether, being melted by heating at a temperature higher than 175° C, and then the injecting of a fluid at a pressure higher than the atmospheric pressure during, or after the injection of said modified polypherylene ether, or said polymer alloy or polymer blend containing said

modified p[redacted]henylene ether.

4. A method for manufacturing a resin molded article made of a polymer alloy or polymer blend containing a polycarbonic ester derived from an aromatic dihydroxy compound and polystyrenic resin, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 4.5/1000 and 6.5/1000, the injecting of said polymer alloy or polymer blend containing said polycarbonic ester derived from said aromatic dihydroxy compound and polystyrenic resin, said polymer alloy or polymer, blend being melted by heating at a temperature higher than 175° C, and then the injecting of a fluid at a pressure higher than the atmospheric pressure during, or after the injection of said polymer alloy or polymer blend.
5. A method for manufacturing a resin molded article in accordance with Claim 4, said styrenic resin is

   A: A copolymer of vinyl cyanide and styrenic monomer containing a graft rubber in which a graft copolymer of vinyl cyanide and styrenic monomer containing dienic rubber and/or acrylic rubber and/or olefinic rubber is (are) compounded.

   B: A graft copolymer of a styrenic polymer and a styrenic monomer containing a dienic rubber and/or an acrylic rubber and/or an olefinic rubber.

   C: A copolymer of a styrenic monomer in which a graft copolymer of a dienic rubber and/or an acrylic rubber and/or definic rubber and a styrenic monomer is(are) compounded.
6. A method for manufacturing a resin molded article in accordance with Claims 1 to 5, wherein said fluid is injected into said mold cavity from the injecting nozzle of an injection molding machine.
7. A method for manufacturing a resin molded article in accordance with Claims 1 to 5, wherein said fluid is injected into said molded article by using one or more injecting needle(s) and/or injecting nozzle(s) through a sprue runner.
8. A method for manufacturing a resin molded article in accordance with Claims 1 to 5, wherein said fluid is directly injected into said molded article by using one or more injecting needle(s) and/or injecting nozzle(s).
9. A method for manufacturing a resin molded article made of an acrylonitrile-butadiene-styrene copolymer, or a polymer alloy or polymer blend containing said acrylonitrile-butadiene-styrene copolymer, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 5.5/1000 and 7.5/1000, and the injecting of said acrylonitrile-butadiene-styrene copolymer, or said polymer alloy or polymer blend containing said acrylonitrile-butadiene-styrene copolymer, into

said mold cavity, said copolymer, or said polymer alloy or polymer blend, containing a blowing agent in an amount of less than 5% by weight, and being melted by heating at a temperature higher than 160° C.

10. A method for manufacturing a resin molded article made of a high impact polystyrene which is a polymer blend of a styrene graft butadiene copolymer and a styrenic polymer, or a polymer alloy or polymer blend containing said high impact polystyrene, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 5.5/1000 and 7.3/1000, and the injecting of said high impact polystyrene, or said polymer alloy or polymer blend containing said high impact polystyrene, into said mold cavity, said high impact polystyrene, or said polymer alloy or polymer blend, containing a blowing agent in an amount of less than 5% by weight, and being melted by heating at a temperature higher than 160° C.
11. A method for manufacturing a resin molded article made of a modified polyphenylene ether, or a polymer alloy or polymer blend containing said polyphenylene ether, comprising; the preparation of a mold whose cavity is designed to set the shrinkage ratio of said resin molded article into a range of between 5.5/1000 and 7.5/1000, and the injecting of said modified polyphenylene ether, or said polymer alloy or polymer blend containing said modified polyphenylene ether into said mold cavity, said modified polyphenylene ether, or said polymer alloy or polymer blend, containing a blowing agent in an amount of less than 5% by weight, and being melted by heating at a temperature higher than 175° C.
12. A method for manufacturing a resin molded article in accordance with Claims 1 to 11, wherein said resin being injection molded is a recycled resin or a mixture of a virgin resin and a recycled resin in which said recycled resin is contained in an amount of more than 1% by weight.

ABSTRACT

The object of the present invention is to provide a method for manufacturing a resin molded article with a shrinkage ratio that fluctuates little, even if its molding condition(s) is(are) changed, providing a resin molded article with an accurate size.

To attain this object, a mold whose cavity is designed to set the shrinkage ratio of the objective resin molded article into a predetermined range is prepared, and the resin, melted by heating at a temperature higher than 160° C, is injected into said cavity of said mold, after which a further fluid is injected into said melting resin, at a predetermined pressure.